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Indian Standard

SCHEDULES FOR WROUGHT STEELS

PART 2 CARBON STEELS (UNALLOYED STEELS)

Section 2 Carbon Steel Wires with Related Properties

(*First Revision*)

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SCHEDULES FOR WROUGHT STEELS

PART 2 CARBON STEELS (UNALLOYED STEELS)

Section 2 Carbon Steel Wires with Related Properties

(*First Revision*)

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Indian Standard

SCHEDULES FOR WROUGHT STEELS

PART 2 CARBON STEELS (UNALLOYED STEELS)

Section 2 Carbon Steel Wires with Related Properties

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 2/Sec 2) (First Revision) was adopted by the Bureau of Indian Standards on 25 June 1987, after the draft finalized by the Alloy Steels and Special Steels Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 Schedules for wrought steels for general engineering purposes (IS : 1570) was first published in 1961. On the basis of the experience gained in the production and use of steels, the Sectional Committee has decided to revise the standard and issue it in parts. The other parts of the standard are as follows:

Part 1 Steels specified by tensile and/or yield properties.

Part 2 Carbon steels (unalloyed steels), Section 1 Wrought products (other than wires) with specified chemical composition and related properties.

Part 3 Carbon and carbon manganese free cutting steels.

Part 4 Alloy steels (alloy constructional and spring steels) with specified chemical composition and related mechanical properties (*under revision*).

Part 5 Stainless and heat resisting steels.

Part 6 Alloy tool steels (*under revision*).

Part 7 Steels for elevated temperature services (creep resisting steels) (*under revision*).

0.3 The following major modifications have been made in this revision:

a) Tensile strength values are given in MPa instead of kg/mm^2.

b) The detailed mechanical properties of different types of wires for various end uses have been included.

1. SCOPE

1.1 This schedule (Part 2/Sec 2) is applicable to wire produced from carbon steels for a wide variety of purposes.

2. GENERAL

2.1 In many cases, the necessary properties are produced in the wire by cold drawing rod or wire, after appropriate heat treatment, from a predetermined size to the required diameter. As the tensile strength thus attained is a function of both the initial and final diameters, by selection of a steel of suitable composition, appropriate preliminary heat treatment, for example, annealing or patenting; and appropriate initial diameter; a wide variety of tensile strengths may be obtained. The very high tensile strength can, however, only be attained in the smaller sizes owing to the large amount of cold drawing required.

In many cases, it is sufficient to specify the tensile properties without specifying a chemical composition, other than the maximum permissible limits of sulphur and phosphorus, but when detailed chemical composition is considered necessary, these may be selected from steels in Part 2, Sec 1 in relation to the diameter of the wire and the tensile strength level required.

Table 1 specifies the tensile strength limits for mild steel wire while Tables 2 to 13 refer to drawn wire for wood screws, rivets, spokes and nipples, bead wire for tyres, staple pins, needles, umbrella ribs, split pins, reeds and steel wire for aluminium conductors. The specified tensile properties for hard drawn wire for ropes, upholstery springs, telegraph and telephone wires, cold formed springs, valve springs, etc, are covered in Tables 14 to 18. The hard drawn wires for prestressed concrete and concrete reinforcement are covered in Tables 19-22.

Any tests, additional to the tensile test, for example, torsion test, wrapping test, etc, should be specified in the standard as appropriate.

TABLE 1 SPECIFIED TENSILE LIMITS FOR MILD STEEL WIRE

(*Clause* 2.1)

CONDITION	TENSILE STRENGTH MPa
Annealed	500 *Max*
Soft drawn	550 *Max*
¼ Hard	450-650
½ Hard	600-800
Hard	700-959

TABLE 2 SPECIFIED TENSILE LIMITS FOR WIRE FOR WOOD SCREWS AND MACHINE SCREWS

(*Clause* 2.1)

	Tensile Strength MPa
Wood screw	460 *Min*
Machine screw — Grade I	440-590
Grade II	590-780

TABLE 3 SPECIFIED TENSILE PROPERTIES FOR STEEL WIRE FOR COLD-FORGED RIVETS (UP TO 20 mm)

(*Clause* 2.1)

	Tensile Strength MPa	Yield Stress MPa *Min*	Elongation, Percent *Min* (on Gauge Length) $5.65 \sqrt{S_0}$
Annealed condition	330-410	160	30
As drawn condition	410-490	190	20

TABLE 4 SPECIFIED TENSILE LIMITS FOR STEEL WIRE FOR SPOKES AND NIPPLES

(*Clause* 2.1)

	Tensile Strength MPa
Spoke	1 000-1 300
Nipple	490-640

TABLE 5 SPECIFIED TENSILE PROPERTIES FOR BEAD WIRE FOR TYRES

(*Clause* 2.1)

Size of Wire mm	Tensile Strength MPa (*Min*)	Elongation at 200 mm (GL) Percent, *Min*
0·965	1 860	3
1·80	1 720	3
	1 470	3
1·83	1 720	3
2·49	1 420	4

Note — Bronze, brass and copper plated wires shall be heated in superheated steam at 150°C for one hour before testing.

1 MPa = 1 N/mm² = 1 MN/m² = 0·102 0 kgf/mm².

TABLE 6 SPECIFIED TENSILE LIMITS FOR STEEL WIRE FOR STAPLES, PINS AND CLIPS

(*Clause* 2.1)

TYPE	TENSILE STRENGTH MPa
1	590-880
2	685-980
3	1 175-1 570

TABLE 7 SPECIFIED TENSILE LIMITS FOR STEEL WIRE FOR NEEDLES

(*Clause* 2.1)

GRADE	TENSILE STRENGTH MPa
I	610-730
II	630-760
III	490-690

TABLE 8 SPECIFIED TENSILE LIMITS FOR WIRE FOR UMBRELLA RIBS

(*Clause* 2.1)

TYPE OF WIRE	GRADE	SIZE RANGE mm	TENSILE STRENGTH MPa
Hardened/tempered	1	1·60-3·00	1 570-1 870
As drawn	2	1·60-4·00	1 270-1 570
As drawn	3	1·60-2·50	1 570-1 870

TABLE 9 SPECIFIED TENSILE PROPERTIES FOR WIRE FOR SPLIT PINS

(*Clause* 2.1)

NOMINAL SIZE		GAUGE LENGTH	TENSILE STRENGTH	ELONGATION, PERCENT
Over	Up to	mm	MPa, *Max*	*Min*
—	1·6	125	450	10
1·6	4	250	450	10
4		8 times the nominal size	450	20

TABLE 10 SPECIFIED TENSILE LIMITS FOR STEEL WIRE FOR REEDS

(*Clause* 2.1)

TENSILE STRENGTH MPa
600-900

TABLE 11 SPECIFIED TENSILE LIMITS FOR STEEL WIRE FOR HEALD

(*Clause* 2.1)

TENSILE STRENGTH MPa	
1 100 *Min*	Hardened and tempered
a) 1 300-1 700	Patented and drawn
b) 1 600-2 000	

TABLE 12 SPECIFIED TENSILE PROPERTIES FOR DRAWN TINNED STEEL WIRE FOR BANDING ARMATURES AND ROTORS

(*Clause* 2.1)

TENSILE STRENGTH MPa, *Min*	0·2 PERCENT PROOF STRESS MPa, *Min*
1 760	1 280

TABLE 13 SPECIFIED TENSILE PROPERTIES FOR ALUMINIZED STEEL CORE WIRE FOR ALUMINIUM CONDUCTORS (ACSR)

(*Clause* 2.1)

NOMINAL DIAMETER mm		TENSILE STRENGTH MPa, *Min*	STRESS AT 1 PERCENT EXTENSION *Min* MPa	ELONGATION PERCENT *Min* (Gauge Length = 250 mm)
Over	Up to			
1·25	2·24	1 275	1 170	3·5
2·24	3·15	1 240	1 100	4·0
3·15	3·55	1 205	1 030	4·0
3·55	3·76	1 170	1 000	5·0
3·75		1 135	930	5·0

TABLE 14 SPECIFIED TENSILE LIMITS FOR HARD DRAWN STEEL WIRE FOR ROPES

(*Clause* 2.1)

TENSILE DESIGNATION	TENSILE STRENGTH MPa
1230	1 230-1 620
1420	1 420-1 810
1570	1 570-1 960
1770	1 770-2 160
1960	1 960-2 340

TABLE 15 SPECIFIED BREAKING LOAD FOR STEEL WIRE FOR TELEGRAPH AND TELEPHONE

(*Clause* 2.1)

NOMINAL DIAMETER mm	BREAKING LOAD*, *N* *Min*
1·50	660
1·80	940
2·0	1 160
2·12	1 305
2·50	1 815
2·80	2 295
3·55	3 660
4·0	4 680
5·60	9 170

*The values are based on nominal diameter of wire.

TABLE 16 SPECIFIED TENSILE LIMITS FOR HARD DRAWN STEEL WIRE FOR UPHOLSTERY SPRING

(*Clause* 2.1)

NOMINAL DIAMETER mm	TENSILE STRENGTH, MPa	
	Grade I	Grade II
1·20 to 2·00	1 700-2 000	2 000 to 2 300
2·10 to 2·65	1 550-1 750	1 750-1 950
2·80 to 3·55	1 450-1 650	1 600-1 800
4·00	1 450 *Min*	1 450 *Min*

TABLE 17 PHYSICAL PROPERTIES OF PATENTED AND COLD DRAWN STEEL WIRE FOR COLD FORMED SPRINGS

(*Clause* 2.1)

UNCOATED WIRE DIA (NOMINAL) mm	TENSILE STRENGTH, MPa, *Min*				REDUCTION IN AREA, PERCENT, *Min*
	Grade 1	Grade 2	Grade 3	Grade 4	
(1)	(2)	(3)	(4)	(5)	(6)
0·07	—	—	2 550	—	—
0·08	—	—	2 540	—	—
0·09	—	—	2 530	—	—
0·10	—	—	2 530	—	—

(*Continued*)

TABLE 17 PHYSICAL PROPERTIES OF PATENTED AND COLD DRAWN STEEL WIRE FOR COLD FORMED SPRINGS — *Contd*

Uncoated Wire Dia (Nominal) mm	Tensile Strength, MPa, *Min*				Reduction in Area, Percent, *Min*
	Grade 1	Grade 2	Grade 3	Grade 4	
(1)	(2)	(3)	(4)	(5)	(6)
0·11	—	—	2 520	—	—
0·12	—	—	2 520	—	—
0·14	—	—	2 510	—	—
0·16	—	—	2 500	—	—
0·18	—	—	2 500	—	—
0·20	—	—	2 490	2 700	—
0·22	—	—	2 480	2 680	—
0·25	—	—	2 470	2 670	—
0·28	—	—	2 460	2 660	—
0·30	1 720	2 060	2 460	2 660	—
0·32	1 710	2 050	2 450	2 650	—
0·34	1 710	2 050	2 450	2 640	—
0·36	1 700	2 040	2 440	2 630	—
0·38	1 700	2 040	2 430	2 620	—
0·40	1 700	2 040	2 430	2 620	—
0·43	1 690	2 030	2 420	2 610	—
0·45	1 680	2 020	2 410	2 600	—
0·48	1 680	2 020	2 400	2 590	—
0·50	1 670	2 010	2 390	2 580	—
0·53	1 660	2 000	2 380	2 570	—
0·56	1 660	2 000	2 370	2 560	—
0·60	1 650	1 990	2 360	2 550	—
0·63	1 640	1 980	2 340	2 540	—
0·65	1 640	1 980	2 330	2 540	—
0·70	1 630	1 970	2 320	2 530	—
0·75	1 620	1 960	2 300	2 500	—
0·80	1 610	1 950	2 280	2 480	—
0·85	1 600	1 930	2 260	2 460	—
0·90	1 590	1 920	2 250	2 440	—
0·95	1 580	1 910	2 250	2 420	—
1·00	1 570	1 900	2 240	2 400	—
1·05	1 560	1 890	2 210	2 380	40
1·10	1 550	1 880	2 190	2 370	

(Continued)

TABLE 17 PHYSICAL PROPERTIES OF PATENTED AND COLD DRAWN STEEL WIRE FOR COLD FORMED SPRINGS — *Contd*

UNCOATED WIRE DIA (NOMINAL) mm	TENSILE STRENGTH, MPa, *Min*				REDUCTION IN AREA, PERCENT, *Min*
	Grade 1	Grade 2	Grade 3	Grade 4	
(1)	(2)	(3)	(4)	(5)	(6)
1·20	1 540	1 860	2 170	2 340	40
1·25	1 530	1 850	2 140	2 320	
1·30	1 520	1 840	2 130	2 300	
1·40	1 500	1 820	2 110	2 290	
1·50	1 490	1 800	2 100	2 260	
1·60	1 470	1 780	2 080	2 250	
1·70	1 460	1 760	2 050	2 220	
1·80	1 440	1 750	2 030	2 190	
1·90	1 430	1 730	2 010	2 180	
2·0	1 420	1 720	1 990	2 160	
2·1	1 410	1 700	1 960	2 130	
2·25	1 400	1 680	1 940	2 100	
2·40	1 380	1 660	1 910	2 070	
2·5	1 370	1 640	1 890	2 050	
2·6	1 360	1 620	1 860	2 030	
2·8	1 340	1 600	1 840	2 000	
3·0	1 320	1 570	1 830	1 980	
3·2	1 310	1 550	1 790	1 960	
3·4	1 290	1 530	1 760	1 920	
3·6	1 270	1 510	1 750	1 890	
3.8	1 260	1 490	1 720	1 860	
4·0	1 250	1 480	1 700	1 840	35
4·25	1 250	1 460	1 680	1 820	
4·5	1 230	1 440	1 660	1 800	
4·75	1 210	1 420	1 620	1 770	
5·0	1 190	1 390	1 600	1 750	
5·3	1 170	1 370	1 570	1 720	
5·6	1 150	1 350	1 550	1 690	
6·0	1 130	1 320	1 530	1 670	
6·3	1 120	1 310	1 500	1 640	
6·5	1 110	1 290	1 480	1 620	
7·0	1 090	1 260	1 460	1 610	
7·5	1 070	1 250	1 430	1 570	30
8·0	1 050	1 220	1 400	1 540	
8·5	1 020	1 200	1 370	1 500	
9·0	1 000	1 180	1 350	1 480	
9·5	990	1 150	1 310	—	—
10·0	980	1 130	1 290	—	—
10·5	—	1 100	—	—	—
11·0	—	1 080	—	—	—
12·0	—	1 040	—	—	—
12·5	—	1 030	—	—	—
13·0	—	1 020	—	—	—
14·0	—	990	—	—	—
15·0	—	970	—	—	—
16·0	—	960	—	—	—
17·0	—	950	—	—	—

NOTE 1 — 1 MPa = 1 N/mm^2 = 1 MN/m^2 = 0·1 020 kgf/mm^2.

NOTE 2 — The maximum tensile strength of a particular grade shall be the minimum tensile strength of the next higher grade subject to a maximum range of 250 N/mm^2 between the maximum and the minimum. In case of Grade 4, the higher limit may be mutually agreed to between the purchaser and the manufacturer.

TABLE 18 TENSILE PROPERTIES OF OIL HARDENED AND TEMPERED SPRING STEEL WIRE AND VALVE SPRING WIRE

(*Clause* 2.1)

WIRE DIA (NOMINAL)	TOLERANCE	TENSILE STRENGTH, MPa, *Min*, FOR GRADES		REDUCTION IN AREA, PERCENT, *Min*, FOR GRADES	
mm (1)	mm (2)	SW (3)	VW (4)	SW (5)	VW (6)
1·00 1·05 1·10	± 0·015	1 760 to 1 960	1 670 to 1 810	45	45
1·20 1·25 1·30 1·40		1 720 to 1 910	1 620 to 1 760		
1·50 1·60 1·70 1·80 1·90	± 0·020	1 670 to 1 860	1 570 to 1 690		
2·0 2·1 2·25 2·4	± 0·030	1 620 to 1 760	1 520 to 1 620		
2·5 2·6 2·8		1 570 to 1 720	1 470 to 1 620		
3·0 3·2		1 520 to 1 670	1 430 to 1 530		
3·4	± 0·04				
3·6 3·8		1 480 to 1 630	1 400 to 1 500		
4·0				42	42
4·25		1 440 to 1 590	1 370 to 1 470		
4·5					
4·75 5·0				40	40
5·3 5·6		1 400 to 1 550	1 340 to 1 440		
6·0	± 0·06				

(*Continued*)

TABLE 18 TENSILE PROPERTIES OF OIL HARDENED AND TEMPERED SPRING STEEL WIRE AND VALVE SPRING WIRE — *Contd*

WIRE DIA (NOMINAL)	TOLERANCE	TENSILE STRENGTH, MPa, *Min*, FOR GRADES		REDUCTION IN AREA, PERCENT, *Min*, FOR GRADES	
6·3	± 0·06	1 360 to 1 510	1 300 to 1 400	40	40
6·5 7·0 7·5				38	38
8·0		1 290 to 1 440	—		
8·5					—
9·0 9·5	± 0·08			35	
10·0		1 250 to 1 400	—		
10 5 11·0 12·0 12·5 13·0 14·0	± 0·12				

NOTE — 1 N/mm² = 1 MN/m² = 0·1 020 kgf/mm².

TABLE 19 SPECIFIED TENSILE LIMITS FOR HARD DRAWN STEEL WIRE FOR PRESTRESSED CONCRETE

(*Clause* 2.1)

NOMINAL DIAMETER mm	TENSILE STRENGTH MPa *Min*
3·25	1 765
4·00	1 715
5·00	1 570

NOTE — 1 N/mm² = 1 MN/m² = 0·1 020 kgf/mm².

TABLE 20 SPECIFIED TENSILE LIMITS FOR COLD DRAWN AND STRESS RELIEVED WIRE FOR PRESTRESSED CONCRETE

(*Clause* 2.1)

Nominal Diameter mm	Tensile Strength, *Min* MPa	Elongation, Percent *Min* (GL 200 mm)
2·50	2 010	2·50
3·00	1 860	2·50
4·00	1 715	3·00
5·00	1 570	4·00
7·00	1 470	4·00
8·00	1 370	4·00

TABLE 21 SPECIFIED TENSILE PROPERTIES FOR HARD DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT

(*Clause* 2.1)

Tensile Strength MPa	0·2 Percent Proof Stress MPa	Elongation, Percent (GL 8D)
570, *Min*	480, *Min*	7·5 *Min*

TABLE 22 SPECIFIED TENSILE PROPERTIES FOR INDENTED HARD DRAWN STEEL WIRE FOR PRESTRESSED CONCRETE

(*Clause* 2.1)

Nominal Diameter mm	Tensile Strength *Min* MPa	0·2 Percent Proof Stress, *Min* MPa	Elongation Percent, *Min* (GL 200 mm)
5·00	1 570	1 335	3·5
4·00	1 715	1 460	3
3·00	1 860	1 580	2·5

(*Continued from page* 2)

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Shri D. K. Das (*Alternate*)	
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Shri K. K. Sen	Pratap Steel Rolling Mills Ltd, Ballabgarh
Shri S. N. Singh	Tata Engineering & Locomotive Co Ltd, Jamshedpur
Dr G. Venkataraman	Bharat Heavy Electricals Ltd, Tiruchchirappalli
Shri D. P. Vernekar	Visvesvaraya Iron & Steel Ltd, Bhadravati
Shri B. Haridasa Achar (*Alternate*)	